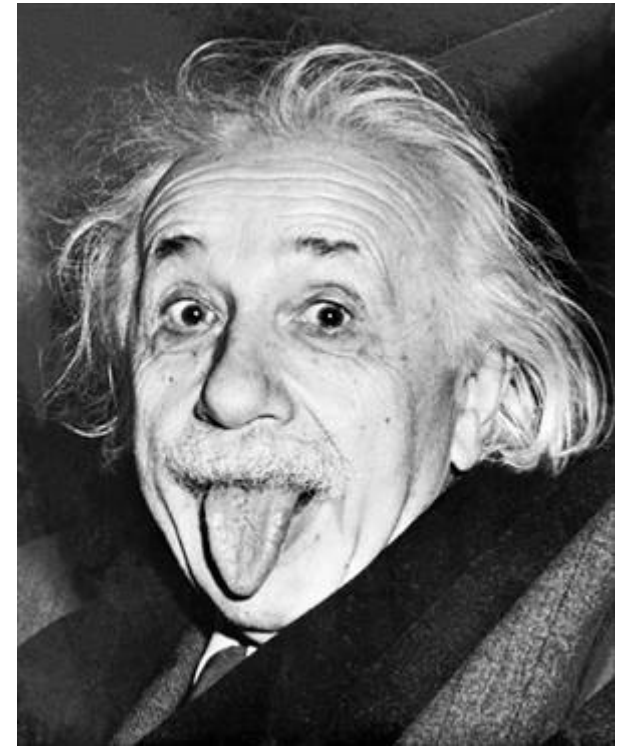
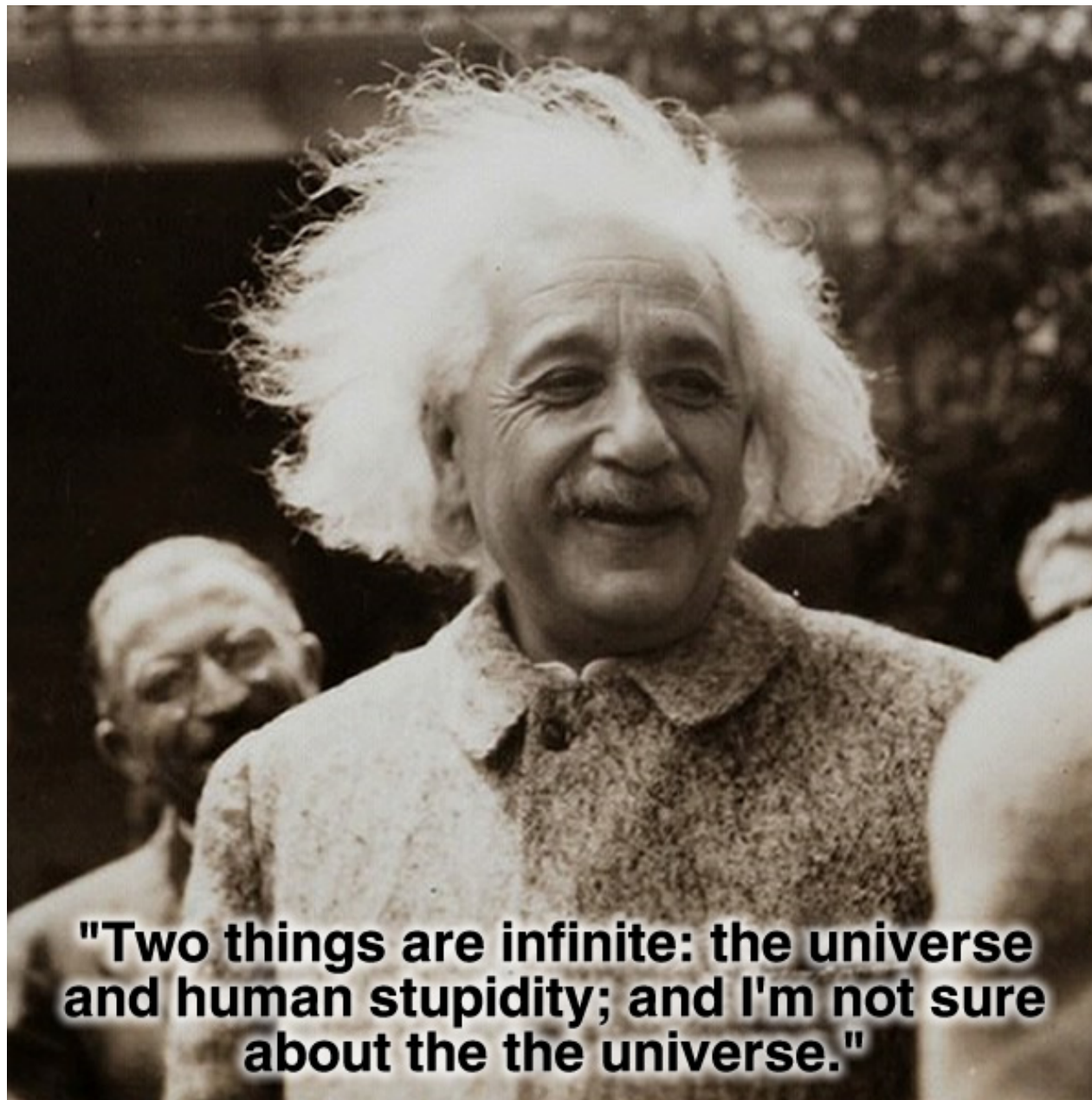


The Nature of Science





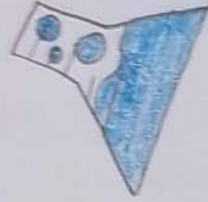




Carrie
Winkepleck



Science



Becky Graber



Marla Stoll



What is Science...

- You get to know stuff and be really smart.
- doing experiments
- You get to find things like bugs or butterflies.
- You learn what stuff is.
- You can look under a microscope to see small things.
- the study of volcanoes.
- learning about space.
- looking through a telescope at the stars,

What is science?



plants



earth
and
space



animals

I am a Scientist



I am a scientist.

I can ask questions.

I can explore.

I can measure.

I can learn.



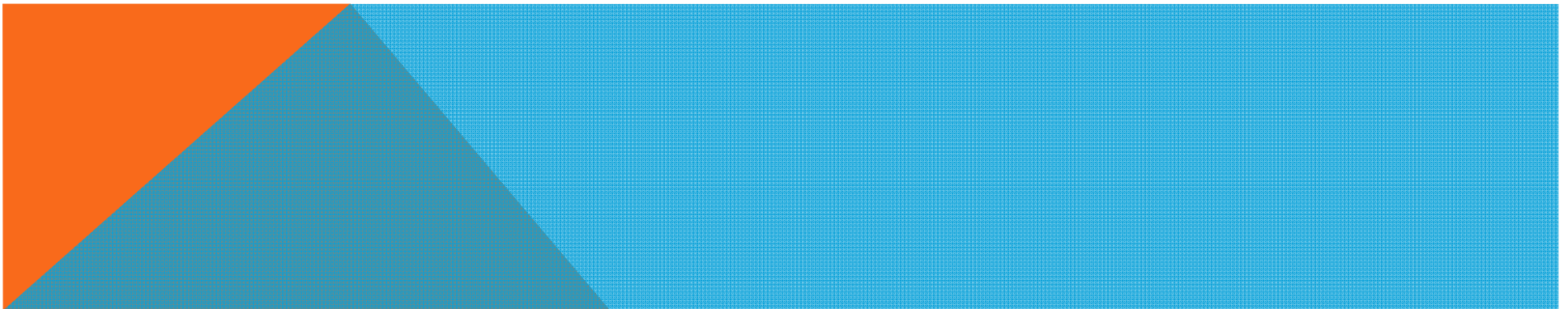


PRE CONCEPTIONS AND MISCONCEPTIONS

Students come to science class with alternative conceptions of the real world that are highly resistant preconceptions

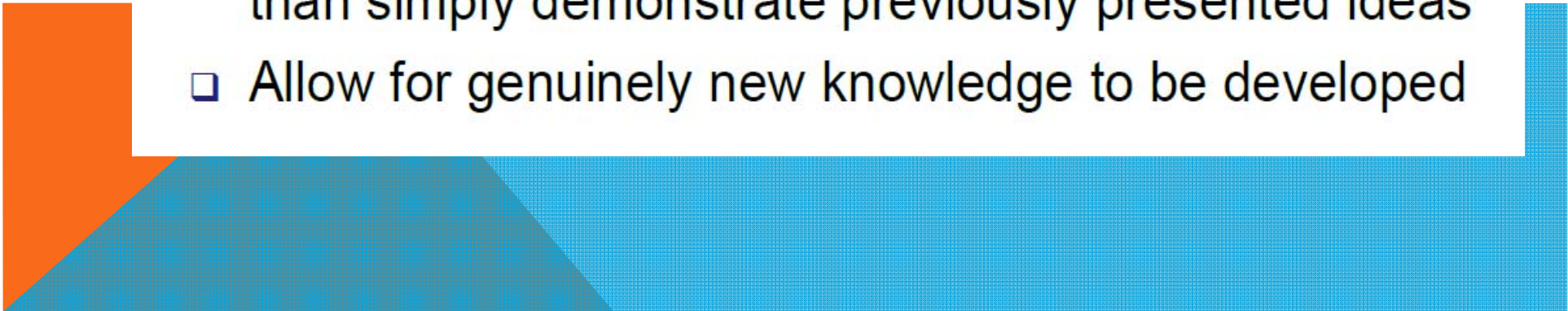
- misapplied conceptions,
- “naive” attempts to explain the natural world,
- highly resistant to change.

Can you think of any?



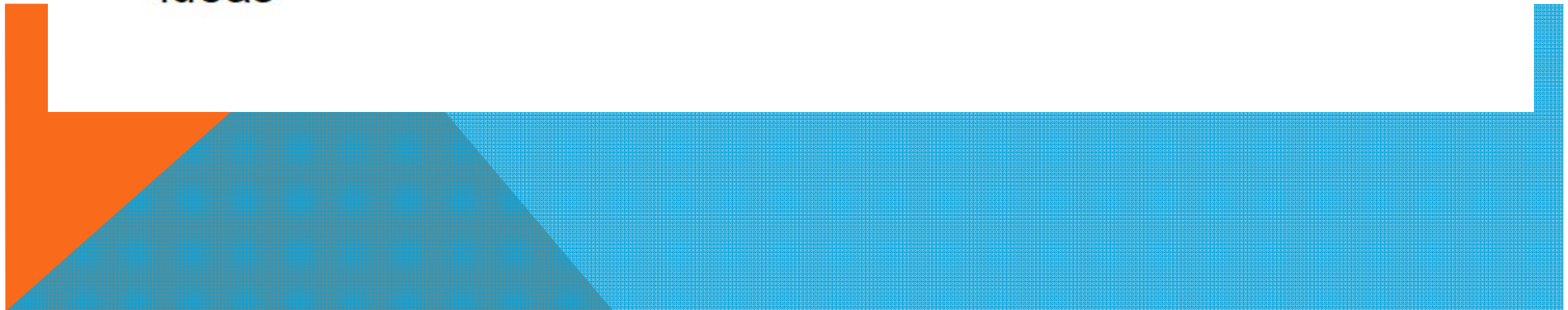


Inquiry based pedagogies

- ❑ Involve students in initial exploration before ideas are introduced and explanations developed
 - ❑ Incorporate students' own questions
 - ❑ Involve students making decisions as part of investigations
 - ❑ Use activities to explore and develop ideas rather than simply demonstrate previously presented ideas
 - ❑ Allow for genuinely new knowledge to be developed
- 

A focus on scientific literacy

- ❑ thinking and working scientifically
- ❑ engaging with the science - technology- society interface
- ❑ science in context
- ❑ social and ethical and economic issues
- ❑ the nature of science and its contemporary setting
- ❑ development of a positive disposition to engage with science ideas



Scientific Method (1 serving)

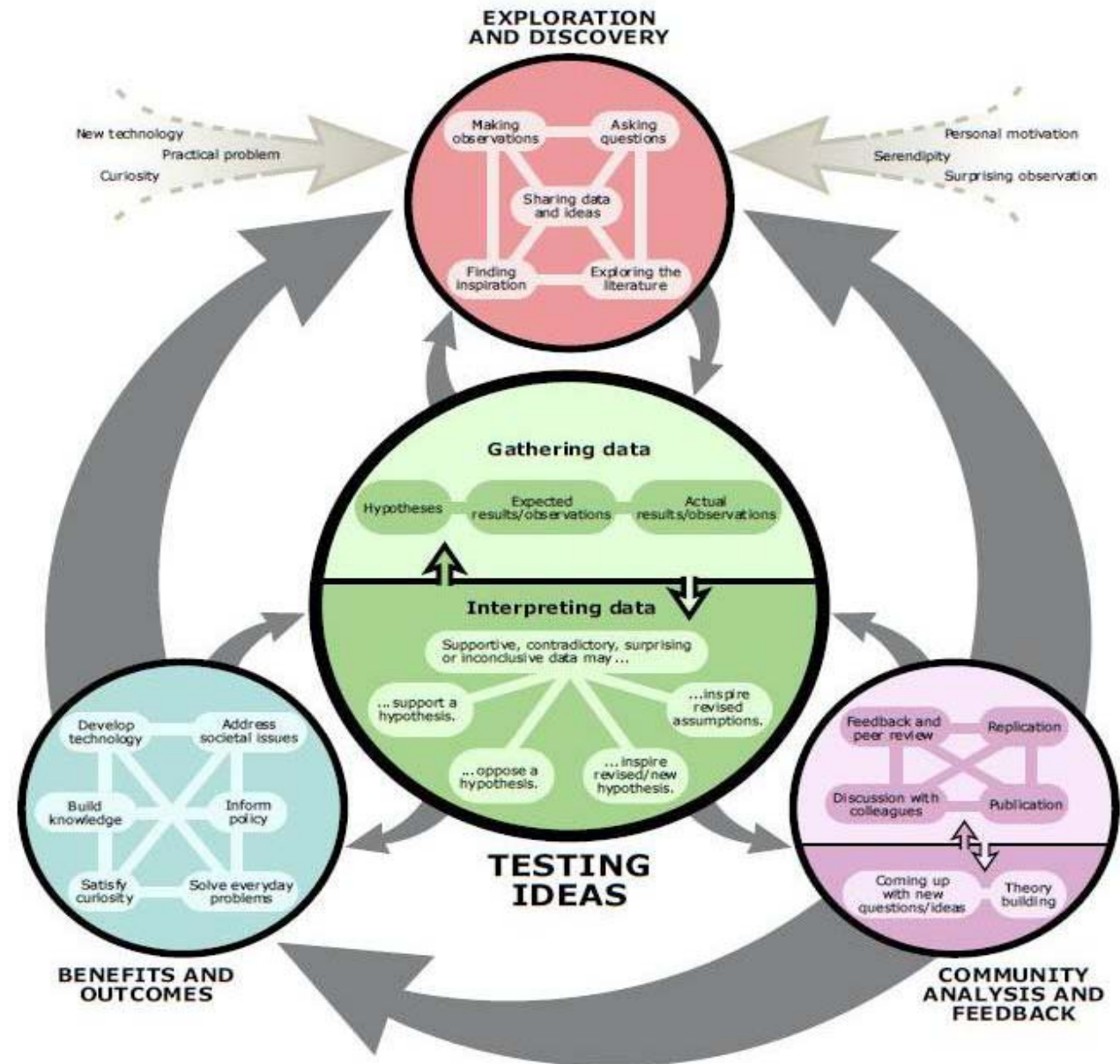
1. Ask a question.
2. Formulate a hypothesis.
3. Perform experiment.
4. Collect data.
5. Draw conclusions.

Bake until thoroughly cooked.

Garnish with additional observations.

linear and "cookbook": pull a problem off the shelf, throw in an observation, mix in a few questions, sprinkle on a hypothesis, put the whole mixture into a 350° experiment — and *voilà*, 50 minutes later you'll be pulling a conclusion out of the oven!

How science works



The *Working Scientifically* approach to open investigation work in science

What are open investigations?

How does investigation work open the door to conceptual learning?

What does it mean to investigate scientifically?

How does investigation work fit the 5Es model of instruction?

Mark Hackling (2005)

<http://www.det.wa.edu.au/education/science/teach/workingscientificallyrevised.pdf>

Variables

**Variables are
things that
vary and change**

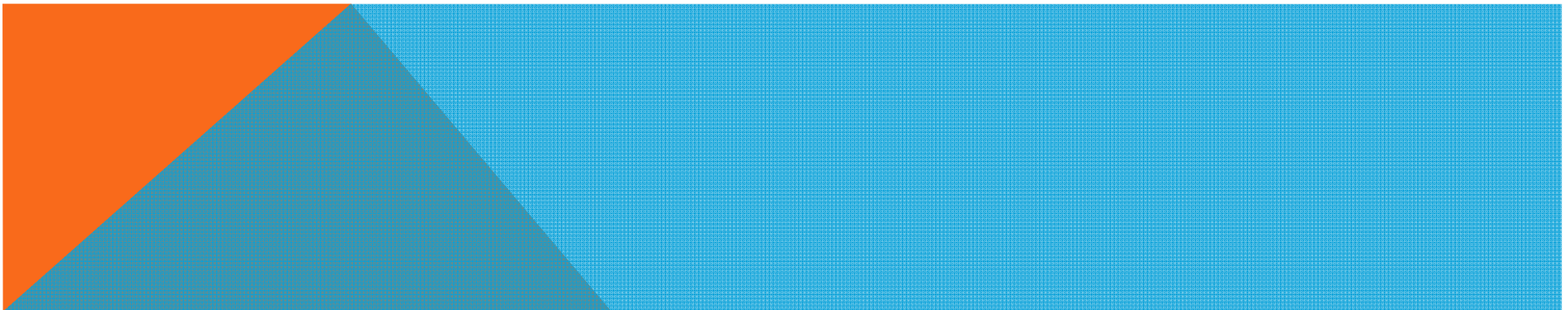


Variables: FAIR TEST

In any experiment there are 2 variables:

- an **independent** (or input) variable
- a **dependent** (or outcome) variable

Let's look at each type....



Independent (input) variable

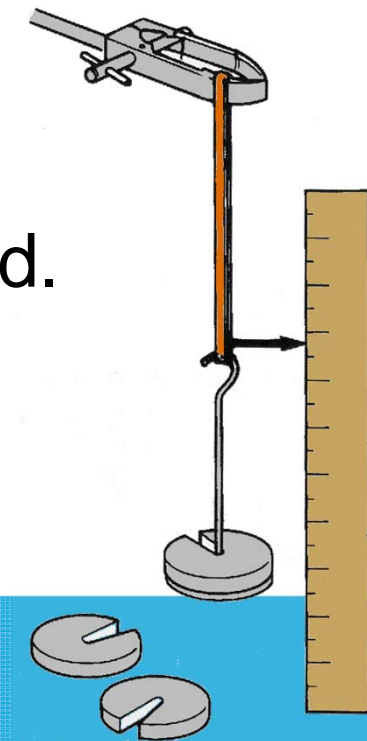
This is the thing that you decide to change.

Example 1

Investigating how a weight affects the length of an elastic band.

You decide the weight to apply,
so:

Weight is the independent variable.



Dependent (outcome) variable

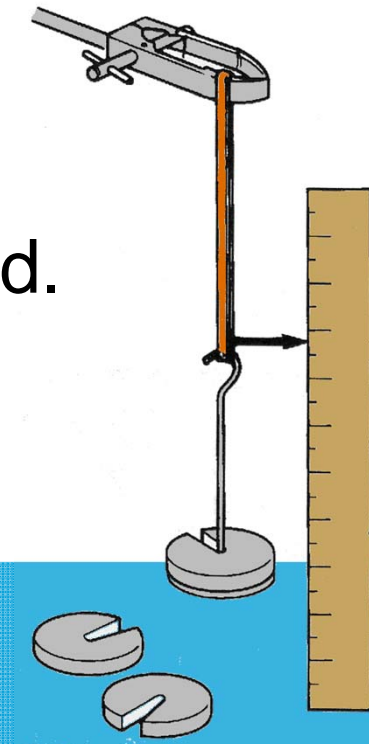
This is the variable that changes as a result.
It is the variable that you measure.

Example 1

Investigating how a weight
affects the length of an elastic band.

You measure the resulting length
of the elastic band, so:

Length is the dependent
variable.



Independent (input) variable

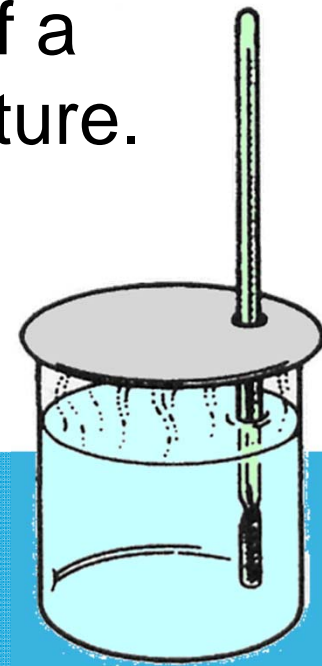
This is the thing that you decide to change.

Example 2

Investigating how the rate of cooling of a beaker depends on the initial temperature.

You decide the initial temperature,
so:

initial temperature is the
independent variable.



Dependent (outcome) variable

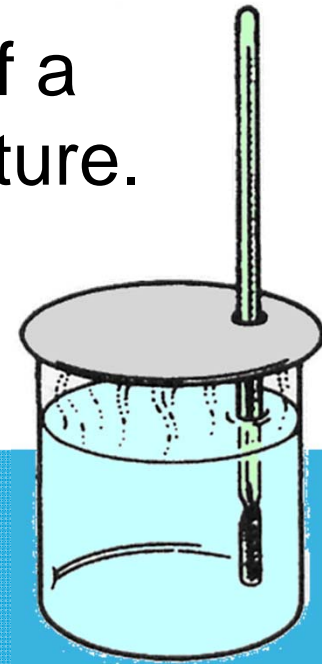
This is the variable that changes as a result.
It is the variable that you measure.

Example 2

Investigating how the rate of cooling of a beaker depends on the initial temperature.

You measure the temperature every minute as it cools, so:

temperature is the dependent variable.



Type of problems to investigate

→ **Decide which ... problems**

Example: Decide which brand of paper towel is best for absorbing spilt water.

→ **Find a way to ... problems**

Example: Find a way of measuring the weight of a suitcase when existing equipment is not adequate.

→ **Find the effect of ... problems**

Example: How does the depth of water in a container affect the rate at which water runs out of a hole in the bottom?

**Type 1. Investigating a relationship between two variables
where repeat trials can be used**

Examples

How does the height from which a ball is released affect the height to which it bounces?

How does the amount of stretch in a rubber band affect the distance it travels when released?

**Type 2. Investigating a relationship between two variables
where replication can be used**

Examples

What effect does temperature have on dissolving of jelly cubes/soluble aspirin tablets?

What effect does temperature have on germination?

A. How can we clean this dirty water?

E. How do plants take in water?

Which of these questions could be answered using a fair test?

B. Which kind of sponge is best for mopping up water?

C. What makes water evaporate in less time?

D. How much of an apple is water?

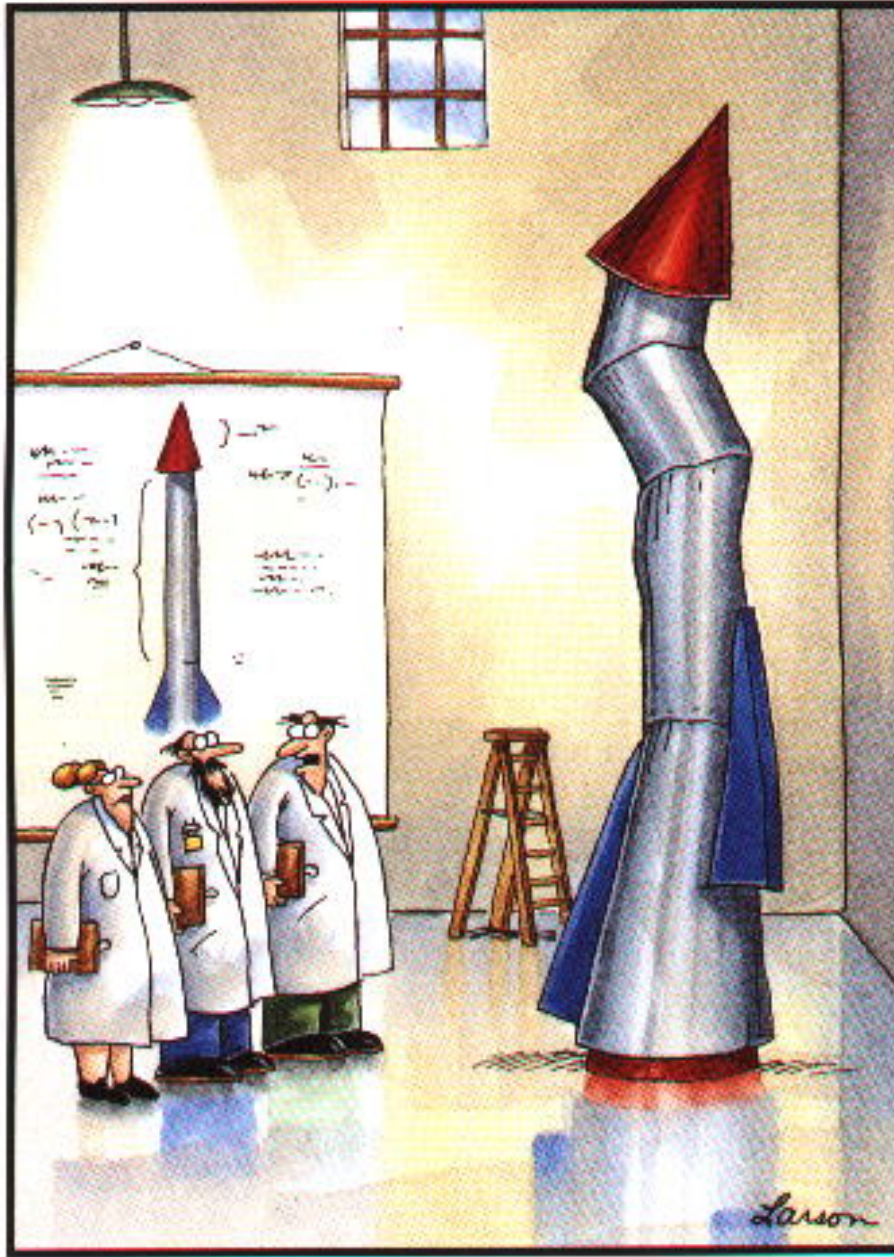
Question	Change one factor (Independent variable)	Measure/ observe something else (Dependent variable)	Suitable for FAIR TEST?
A			
B			
C			
D			
E			

Question	What to change? (Independent variable)	What to measure/observe? (Dependent variable)	"Easiness" of design. (your judgement)
What is the best angle for solar cells?			
How hard does the wind need to blow for a wind turbine to generate power?			
How can I decrease the amount of CO ₂ in the atmosphere?			
How much electricity will be lost when the clouds block out the sun?			
What is the green house effect?			

What happens to _____ when we change _____?
 (dependent variable) (independent variable)

- Develop the question for investigation,
- Identify variables
- Choose variables to change, measure and keep the same,
- Make predictions,
- Plan the materials, equipment and steps
- Observe, measure, calculate
- Collect evidence,
- Record and organise data,

What will I change?	What will I measure?	What will I keep the same?
Independent variable	Dependent variable	Controlled variables



"It's time we face reality, my friends. ...
We're not exactly rocket scientists."

EVALUATING

Develop explanations for the results based on evidence,

Analysis of results in relation to the question, and

Reflect on the investigating process and look for improvements

Communicating

- ▶ Use appropriate representations for the findings of the investigation,
- ▶ Present findings to an audience, and
- ▶ Talk about the evidence



Planning and Report Worksheet for Science Investigations

Student name _____ Class _____

Other members of your group _____

What are you going to investigate?

What do you think will happen? Explain why.

Which variables are you going to:

- change?
- measure?
- keep the same?

How will you make it a fair test?

What equipment will you need?



Planning and Report Worksheet for Science Investigations

Student name _____

Other members of your group _____

Phase one: Planning

What is the problem you are investigating?

What do you know about this topic from personal experience and from science?

What variables may affect the phenomenon you are investigating?

Which of the variables are you going to investigate as your independent variable (this is the variable you will change to see what effect it has on the dependent variable)?

<i>Phase of instructional model</i>	<i>Purpose</i>	<i>Role of reading, writing, practical work and discussion</i>
Engage		
Explore		
Explain		
Elaborate		
Evaluate		
Figure 4. Phases of the 5Es instructional model		